

In the Claims

Claims 1-40 (canceled).

Claim 41 (previously presented): A method of establishing wireless communications between an interrogator and individual multiple wireless identification devices, the method comprising combining tree search and Aloha techniques to establish communications between the interrogator and individual of multiple wireless identification devices.

Claim 42 (previously presented): A method in accordance with claim 41 wherein the Aloha techniques comprise slotted Aloha.

Claim 43 (previously presented): A method in accordance with claim 41 wherein the wireless identification device comprises an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

Claim 44 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices, the method comprising:

establishing a first predetermined number of bits to be used as unique identification numbers; and establishing for respective devices unique identification numbers respectively having the first predetermined number of bits;

establishing a second predetermined number of bits to be used for random values;

causing the devices to select random values, wherein respective devices choose random values independently of random values selected by the other devices;

transmitting a command from the interrogator requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values;

receiving the command at multiple devices, the devices receiving the command respectively determining if the random value chosen by the command falls within the specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of slots; and, if not, not sending a reply; and

determining with the interrogator if a collision occurred between devices that sent a reply and, if so, creating a new, smaller, specified group.

Claim 45 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein the sending of a reply to the interrogator within a randomly selected time slot is in accordance with an Aloha technique.

Claim 46 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein the sending of a reply to the interrogator within a randomly selected time slot is in accordance with slotted Aloha.

Claim 47 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein the method is an adaptive method.

Claim 48 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein the number of slots is four.

Claim 49 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein sending a reply to the interrogator comprises transmitting the unique identification number of the device sending the reply.

Claim 50 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein sending a reply to the interrogator comprises transmitting the random value of the device sending the reply.

Claim 51 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein, after receiving a reply without collision from a device, the interrogator sends a command individually addressed to that device.

Claim 52 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 44 wherein the time slot randomly selected by a device is selected using a random number different from the random value of that device.

Claim 53 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices, the method comprising:

establishing unique identification numbers for respective devices;

causing the devices to select random values, wherein respective devices choose random values independently of random values selected by the other devices;

transmitting from the interrogator a command requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values;

receiving the command at multiple devices, the devices receiving the command respectively determining if the random value chosen by the device falls within the specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of slots; and, if not, not sending a reply; and

determining using the interrogator if a collision occurred between devices that sent a reply and, if so, creating a new, smaller, specified group.

Claim 54 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 53 wherein establishing unique identification numbers for respective devices comprises establishing a predetermined number of bits to be used for the unique identification numbers.

Claim 55 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 54 and further including establishing a predetermined number of bits to be used for the random values.

Claim 56 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of communications devices in accordance with claim 55 wherein the predetermined number of bits to be used for the random values comprises sixteen bits.

Claim 57 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices, the method comprising:

establishing for respective devices unique identification numbers respectively having a first predetermined number of bits;

establishing a second predetermined number of bits to be used for random values;

causing the devices to select random values, wherein respective devices choose random values independently of random values selected by the other devices;

transmitting from the interrogator a command requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values;

receiving the command at multiple devices, the devices receiving the command respectively determining if the random values chosen by the device falls within the specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with an Aloha technique; and, if not, not sending a reply, wherein sending a reply to the interrogator comprises transmitting both the random value of the device sending the reply and the unique identification number of the device sending the reply, and wherein the time slot randomly selected by a device is selected using a random number different from the random value of that device;

determining with the interrogator if a collision occurred between devices that sent a reply and, if so, creating a new, smaller, specified group; and

if a reply without collision is received from a device, the interrogator subsequently sending a command individually addressed to that device.

Claim 58 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 57 wherein the number of possible time slots is four.

Claim 59 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 57 wherein the number of possible time slots is four, wherein the first predetermined number of bits is sixteen, and wherein the second predetermined number of bits is sixteen.

Claim 60 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 57 wherein the number of possible slots varies from one specified group to another.

Claim 61 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 57 and further comprising, after creating a new, smaller, specified group;

the interrogator transmitting a command requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values; and

devices receiving the command respectively determining if their chosen random values fall within the new smaller specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with an Aloha technique.

Claim 62 (previously presented): A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim 61 and further comprising the subsequent steps of the interrogator determining if a collision occurred between devices that sent a reply and, if so, creating a new specified group and repeating the transmitting of the command requesting devices having random values within a specified group of random values to respond using different specified groups until all devices are identified, for every command the devices receiving the command determining if their chosen random values fall within the specified group and, if so, sending a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with an Aloha technique.

Claim 63 (previously presented): A communications system comprising an interrogator, and a plurality of wireless identification devices configured to communicate with the interrogator in a wireless fashion, the respective wireless identification devices having a unique identification number, the interrogator being configured to employ tree search and Aloha techniques to determine the unique identification numbers of the different wireless identification devices so as to be able to establish communications between the interrogator and individual ones of the multiple wireless identification devices without collision by multiple wireless identification devices attempting to respond to the interrogator at the same time.

Claim 64 (previously presented): A communications system in accordance with claim 63 wherein the Aloha technique is a slotted Aloha technique.

Claim 65 (previously presented): A communications system in accordance with claim 63 wherein the wireless identification device comprises an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

Claim 66 (previously presented): A system comprising:

an interrogator;

a number of communications devices capable of wireless communications with the interrogator;

means for establishing a first predetermined number of bits to be used as unique identification numbers, and for establishing for respective devices unique identification numbers respectively having the first predetermined number of bits;

means for establishing a second predetermined number of bits to be used for random values;

means for causing the devices to select random values, wherein respective devices choose random values independently of random values selected by the other devices;

means for causing the interrogator to transmit a command requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values;

means for causing devices receiving the command to determine if their chosen random values fall within the specified group and, if so, send a reply to the interrogator within a randomly selected time slot of a number of slots; and, if not, not send a reply; and

means for causing the interrogator to determine if a collision occurred between devices that sent a reply and, if so, create a new, smaller, specified group.

Claim 67 (previously presented): A system in accordance with claim 66 wherein the sending of a reply to the interrogator within a randomly selected time slot is in accordance with an Aloha technique.

Claim 68 (previously presented): A system in accordance with claim 66 wherein the sending of a reply to the interrogator within a randomly selected time slot is in accordance with a slotted Aloha technique.

Claim 69 (previously presented): A system in accordance with claim 66 wherein the number of slots is four.

Claim 70 (previously presented): A system in accordance with claim 66 wherein sending a reply to the interrogator comprises transmitting the unique identification number of the device sending the reply.

Claim 71 (previously presented): A system in accordance with claim 66 wherein sending a reply to the interrogator comprises transmitting the random value of the device sending the reply.

Claim 72 (previously presented): A system in accordance with claim 66 wherein sending a reply to the interrogator comprises transmitting both the random value of the device sending the reply and the unique identification number of the device sending the reply.

Claim 73 (previously presented): A system in accordance with claim 66 wherein the interrogator further includes means for, after receiving a reply without collision from a device, sending a command individually addressed to that device.

Claim 74 (previously presented): A system in accordance with claim 66 wherein the time slot randomly selected by a device is selected using a random number different from the random value of that device.

Claim 75 (previously presented): A system comprising:

- an interrogator configured to communicate to a selected one or more of a number of communications devices;
- a plurality of communications devices;
- the devices being configured to select random values, wherein respective devices choose random values independently of random values selected by the other devices;
- the interrogator being configured to transmit a command requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values;
- devices receiving the command being configured to respectively determine if their chosen random values fall within the specified group and, if so, send a reply to the interrogator within a randomly selected time slot of a number of slots; and, if not, not send a reply; and
- the interrogator being configured to determine if a collision occurred between devices that sent a reply and, if so, create a new, smaller, specified group.

Claim 76 (previously presented): A system in accordance with claim 75 wherein the predetermined number of bits to be used for the random values comprises sixteen bits.

Claim 77 (previously presented): A system comprising:

an interrogator configured to communicate to a selected one or more of a number of communications devices;

a plurality of communications devices, respective devices being configured to store unique identification numbers respectively having a first predetermined number of bits, respective devices being further configured to store a second predetermined number of bits to be used for random values, respective devices being configured to select random values independently of random values selected by the other devices;

the interrogator being configured to transmit a command requesting devices having random values within a specified group of random values to respond, the specified group being less than or equal to the entire set of random values;

devices receiving the command respectively being configured to determine if their chosen random values fall within the specified group and, if so, send a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with an Aloha technique; and, if not, not send a reply, wherein sending a reply to the interrogator comprises transmitting both the random value of the device sending the reply and the unique identification number of the device sending the reply, and wherein the time slot randomly selected by a device is selected using a random number different from the random value of that device;

the interrogator being configured to determine if a collision occurred between devices that sent a reply and, if so, create a new, smaller, specified group; and

the interrogator being configured to send a command individually addressed to a device after communicating with a device without a collision.

Claim 78 (previously presented): A system in accordance with claim 77 wherein the number of possible time slots is four.

Claim 79 (previously presented): A system in accordance with claim 77 wherein the number of possible time slots is four, wherein the first predetermined number of bits is sixteen, and wherein the second predetermined number of bits is sixteen.

Claim 80 (previously presented): A system in accordance with claim 77 wherein the number of possible slots varies from one specified group to another.

Claim 81 (previously presented): A system comprising:

an interrogator configured to communicate to a selected one or more of a number of communications devices;

a plurality of communications devices, respective devices being configured to store unique identification numbers respectively having a first predetermined number of bits, respective devices being further configured to respectively store a second predetermined number of bits to be used for respective random values, respective devices being configured to select random values independently of random values selected by the other devices;

the interrogator being configured to define a group of random values, the group being a subset of all possible values the devices could select, and to transmit a command requesting devices having random values corresponding to any of the random values in the defined group to respond;

devices respectively being configured to, in response to receiving the command, determine if their chosen random values fall within the defined group and, if so, send a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with Aloha; and, if not, not send a reply, wherein sending a reply to the interrogator comprises transmitting both the random value of the device sending the reply and the unique identification number of the device sending the reply, wherein the time slot randomly selected by a device is selected using a random number different from the random value of that device, and wherein the number of possible slots varies from one specified group to another; and

the interrogator being configured to determine if a collision occurred between devices that sent a reply and, if so, to define a new, smaller, specified group.

Claim 82 (previously presented): A system in accordance with claim 81 wherein the number of possible time slots is four.

Claim 83 (previously presented): A system in accordance with claim 81 wherein the number of possible time slots is four, wherein the first predetermined number of bits is sixteen, and wherein the second predetermined number of bits is sixteen.

Claim 84 (previously presented): A system comprising:

an interrogator configured to communicate to a selected one or more of a number of communications devices;

a plurality of communications devices, respective devices being configured to store unique identification numbers, respective devices being further configured to respectively store respective random values, respective devices being configured to select random values independently of random values selected by the other devices;

the interrogator being configured to define a group of random values, the group being a subset of all possible values the devices could select, and to transmit a command requesting devices having random values corresponding to any of the random values in the defined group to respond;

devices respectively being configured to, in response to receiving the command, determine if their chosen random values fall within the defined group and, if so, send a reply to the interrogator within a randomly selected time slot of a number of possible time slots, in accordance with Aloha; and, if not, not send a reply, wherein the number of possible time slots varies from one specified group to another; and

the interrogator being configured to determine if a collision occurred between devices that sent a reply and, if so, to define a new, smaller, specified group.

Claim 85 (new): A method comprising the steps of:

BI sending a first command to a plurality of wireless identification devices to select a first subset of the plurality of wireless identification devices in accordance with an arbitration scheme, the first subset associated with a first branch of a search tree corresponding to a tree search scheme, the first command requesting each of the plurality of wireless identification devices of the first subset to respond approximately simultaneously; and

sending a second command to the plurality of wireless identification devices to select a second subset of the plurality of wireless identification devices in accordance with the arbitration scheme, the second subset associated with a second branch of the search tree, the second command requesting each of the plurality of wireless identification devices of the second subset to respond in an independently selected one of a plurality of time slots in accordance with an Aloha scheme.

Claim 86 (new): The method of claim 85, further comprising the steps of:

detecting a collision between at least two wireless identification devices of the plurality of wireless identification devices; and

skipping at least one level of the search tree in response to detecting the collision.

BI
Claim 87 (new): The method of claim 85, further comprising the step of receiving a plurality of replies from the plurality of wireless identification devices in accordance with the arbitration scheme, each of the plurality of replies including a respective number independently generated by a respective wireless identification device to identify that wireless identification device.

Claim 88 (new): The method of claim 87, wherein the number generated by a respective device is randomly generated.

CONT
Claim 89 (new): The method of claim 85, further comprising the step of sending a third command to request the plurality of wireless identification devices to respond approximately simultaneously, wherein the plurality of wireless identification devices comprises all wireless identification devices capable of communicating and participating in the arbitration scheme when the third command is sent.

Claim 90 (new): The method of claim 89, wherein the third command comprises a mask, the mask to be used to select a portion of an identification number stored in each of the plurality of wireless identification devices for comparison to a value, the mask being "0", such that no portion of the identification number is selected.

BI
Claim 91 (new): The method of claim 85, wherein the first and second commands each comprise a mask and a value, the mask to be used to select a portion of an identification number stored in each of the plurality of wireless identification devices for comparison to the value.

Claim 92 (new): The method of claim 91, wherein the mask indicates a bit length of the value.

Claim 93 (new): The method of claim 92, wherein the mask corresponds to a level of the search tree, and the value corresponds to a subset within the level of the search tree.

CONT
Claim 94 (new): The method of claim 92, wherein the mask is applied bitwise to the identification number to select the portion of the identification number.

Claim 95 (new): The method of claim 85, further comprising the step of receiving a plurality of replies from the second subset of the plurality of wireless identification devices in response to the second command, the second command comprising a mask to be used to select a portion of a number stored in each of the plurality of wireless identification devices for comparison to a value, the plurality of replies excluding the portion of the number.

BI Claim 96 (new): The method of claim 85, further comprising the step of sending a plurality of signals in accordance with the Aloha scheme, each of the plurality of signals indicating to the second subset of wireless identification devices a beginning of each of the plurality of time slots.

Claim 97 (new): A method comprising:

sending a first command to a plurality of wireless identification devices to select a first subset of the plurality of wireless identification devices and to request each wireless identification device of the first subset to respond in an independently selected one of a first number of time slots in accordance with an adaptive Aloha scheme; and

CONT sending a second command to the plurality of wireless identification devices to select a second subset of wireless identification devices and to request each wireless identification device of the second subset to respond in an independently selected one of a second number of time slots in accordance with the adaptive Aloha scheme.

Claim 98 (new): The method of claim 97, wherein the first and second commands each include a respective value to indicate which of the plurality of wireless identification devices are members of the first subset and which of the plurality of wireless identification devices are members of the second subset.

BI
Claim 99 (new): The method of claim 98, further comprising a wireless identification device of the plurality of wireless identification devices receiving the value and comparing the value to a number stored in the wireless identification device to determine if the wireless identification device is a member of any of the first and second subsets.

Claim 100 (new): The method of claim 98, wherein the value is selected to indicate that the first subset includes all wireless identification devices capable of communicating and participating in the adaptive Aloha scheme when the first command is sent.

CONT
Claim 101 (new): The method of claim 97, wherein the first subset includes the second subset.

Claim 102 (new): The method of claim 101, wherein the first subset includes all wireless identification devices capable of communicating and participating in the adaptive Aloha scheme when the first command is sent, and the second subset includes all wireless identification devices capable of communicating and participating in the adaptive Aloha scheme when the second command is sent.

Claim 103 (new): The method of claim 101, wherein the second subset excludes at least one wireless identification device of the first subset that is identified before the second command is sent.

BI
Claim 104 (new): The method of claim 103, further comprising receiving an error-free response from the one wireless identification device of the first subset in response to the first command before the second command is sent, the error-free response including at least a portion of an identification number of the one wireless identification device.

Claim 105 (new): The method of claim 97, further comprising:
receiving a first plurality of replies in response to sending the first command, each of the first plurality of replies including a respective value independently generated by each respective wireless identification device of the first subset; and

CONT
receiving a second plurality of replies in response to sending the second command, each of the second plurality of replies including a respective value independently generated by each respective wireless identification device of the second subset.

Claim 106 (new): The method of claim 105, wherein the respective values are each randomly generated.

Claim 107 (new): The method of claim 105, wherein the respective values are each four bits long.

Claim 108 (new): The method of claim 107, wherein each of the first and second plurality of replies further includes a unique identification number.

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Claim 109 (new): The method of claim 108, further comprising sending a third command individually addressed to one of the plurality of wireless identification devices by sending a four bit value independently generated by the one of the plurality of wireless identification devices.

Claim 110 (new): The method of claim 97, wherein the second number of time slots is different than the first number of time slots, and is determined based on a number of responses received without collision.

CONT
Claim 111 (new): The method of claim 110, wherein the second number of time slots is selected to be less than the first number of time slots if a predetermined number of responses are received without collision in response to the first command.

Claim 112 (new): The method of claim 97, further comprising sending a plurality of signals in accordance with the adaptive Aloha scheme, each of the plurality of signals indicating a beginning of each of the time slots.

Claim 113 (new): The method of claim 97, wherein the one of the second number of time slots in which to respond is independently selected by each respective one of the plurality of wireless identification devices of the second subset using an independently generated respective random number.

Claim 114 (new): A wireless identification device comprising:

BI a receiver to receive a first command comprising a first mask and a first value associated with a search tree of a tree search scheme, the first mask indicating a bit length of the first value;

a memory to store an identification number, a first portion of the identification number to be selected using the first mask and to be compared to the first value in response to receiving the first command in accordance with the tree search scheme; and

CONT a backscatter transmitter to transmit a first response in an independently selected one of a plurality of time slots in accordance with an Aloha scheme if it is determined that the first portion of the identification number is equal to the first value.

Claim 115 (new): The device of claim 114, wherein the receiver is to receive a second command comprising a second mask of "0" and the backscatter transmitter is to transmit a second response in the independently selected one of the plurality of time slots regardless of the identification number.

Claim 116 (new): The device of claim 114, wherein:

BI the receiver is to further receive a second command comprising a second mask and a second value associated with the search tree of the tree search scheme, the second mask indicating a bit length of the second value;

a second portion of the identification number is to be selected using the second mask and is to be compared to the second value in response to receiving the second command in accordance with the tree search scheme; and

the backscatter transmitter is to further transmit a second response, without delay, in accordance with the tree search scheme if it is determined that the second portion of the identification number is equal to the second value.

CONT Claim 117 (new): The device of claim 114, wherein the response excludes the first portion of the identification number.

Claim 118 (new): The device of claim 114, wherein the backscatter transmitter is to time transmission of the first response using synchronization pulses to be received by the receiver in accordance with the Aloha scheme.

Claim 119 (new): A wireless identification device comprising:

BI a receiver operable to receive a first command comprising a first value, and a second command comprising a second value, the first and second values to select a plurality of wireless identification devices;

a memory operable to store a unique identification number; and

CONT a backscatter transmitter operable to transmit a first response in an independently selected one of a first plurality of time slots in accordance with an adaptive Aloha scheme if it is determined, using the first value, that the wireless identification device is to respond to the first command, the backscatter transmitter further operable to transmit a second response in an independently selected one of a second plurality of time slots in accordance with the adaptive Aloha scheme if it is determined, using the second value, that the wireless identification device is to respond to the second command, the second plurality of time slots to be different in number than the first plurality of time slots.

Claim 120 (new): The device of claim 119, wherein the first and second responses are to include a four bit number independently generated by the wireless identification device in addition to the unique identification number, the four bit number to be used to individually address the wireless identification device.

Claim 121 (new): The device of claim 119, wherein the backscatter transmitter is to time transmission of the first and second responses using synchronization pulses to be received by the receiver in accordance with the adaptive Aloha scheme.

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Claim 122 (new): The device of claim 119, wherein the selected one of the first plurality of time slots is to be selected by the wireless identification device using a first randomly generated number and the selected one of the second plurality of time slots is to be selected by the wireless identification device using a second randomly generated number.

CONT
Claim 123 (new): An interrogator comprising:
a transmitter circuit operable to send a command comprising a mask and a value to a plurality of RFID devices to select a subset of the RFID devices associated with a branch of a search tree in accordance with a tree search scheme, the mask indicating a bit length of the value, the transmitter further operable to send coordination pulses to delimit a plurality of time slots during which the subset of the RFID devices are to respond in accordance with an Aloha scheme;

a receiver circuit operable to receive a plurality of backscatter responses from the subset of the RFID devices; and

a collision detection circuit operable to determine if there is a collision in the plurality of responses, the transmitter further operable to send an acknowledgement signal if a response is received without collision.

Claim 124 (new): A system comprising:

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an interrogator to send a command to select a subset of a plurality of RFID devices and to provide coordination pulses to delimit time slots associated with an adaptive Aloha scheme; and

CONT
an RFID device affixed to an object to identify the object, the RFID device, responsive to the interrogator, to send an independently generated number along with a unique identification number in accordance with the adaptive Aloha scheme if the RFID device determines that the RFID device is a member of the subset, the interrogator to individually address the RFID device using the independently generated number.
